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Entrepreneurial Universities and Sustainable Development. The Network Bricolage Process of Academic Entrepreneurs

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Abstract: This paper studies the network bricolage process of academic entrepreneurs (AEs). Based on a qualitative study, surprisingly, it shows how these entrepreneurs still encounter institutional barriers which exist in universities, in particular regarding building the social capital needed for exploiting their business ideas, and they are not, as expected, well connected to the existing formal networks but rather to the informal ones. This paper uses the bricolage approach of entrepreneurship and the literature on academic entrepreneurship, entrepreneurial universities, and social capital. In-depth interviews with key informants were conducted. Specifically, the study reveals the existence of a relevant network bricolage process of these AEs using informal versus formal networks to develop their ventures. As policy implications, there is a need for a better support from different university levels in order to increase the engagement in entrepreneurial activities of the different individuals. Universities should take a more proactive role when fostering AE activity and solve several barriers that still exist regarding knowledge transfer and entrepreneurship (e.g., bureaucracy and lack of confidence). For AEs, they need to take a more proactive role in building networks and ‘see-sawing’ between both types of network (formal and informal). By doing this, they can overcome the lack of knowledge, build trust, and improve word-of-mouth about their companies. All of this will benefit the university knowledge exchange. As a contribution, this paper explains the behavior of individual entrepreneurs when they exploit business ideas using the networks they have at hand in order to overcome institutional barriers in universities. Furthermore, it describes the process of the selection (‘see-sawing’ metaphor) of informal versus formal networks by AEs when applying their network bricolage.

Keywords: academic entrepreneurs; network bricolage; formal networks; informal networks

1. Introduction

The role of universities has been pointed out recently as an important driver of technological innovation and economic/sustainable development [1,2]. Universities are the main agents in the production of new knowledge and the improvement of human capital and now are facing the new role of providing the necessary leadership to advance in the entrepreneurial society by means of promoting entrepreneurial thinking, actions, institutions, and entrepreneurial capital [3], with the so called ‘third stream activities’ [4].

As a consequence, universities have adopted a narrower focus on the transfer of scientists' inventions from laboratories to industry [5], contributing to the economy and the development of the society [6,7]. This strengthened connection between universities and industries means that, at the individual level, there is pressure on academics to better link their research work with economic needs in order to commercialize them [5,8], accelerating the development of the entrepreneurial university [9,10]. This model of a university is supported by an ecosystem that produce, diffuse, absorb, and use new knowledge and these actions can result on entrepreneurial initiatives [11]. For this model, faculty members willing to be academic entrepreneurs (AEs) are relevant agents [12–14], as they are considered the engines of academic entrepreneurship in breaking the ivory tower [15]. In addition, other externalities exist, as these AEs are better teachers and researchers than academics who have not engaged in entrepreneurial activities [16].

One of the most well-known entrepreneurial initiatives in universities are the university spin-outs (USOs) or for-profit firms based on academic research [17]. Furthermore, the literature maintains that USOs are an important vehicle to promote new innovations which can result in new quality jobs, improving the productivity of regional economies [18]. These companies, compared with the other start-ups, have major obstacles at early stages, because of the information asymmetry, uncertainty, and the nature of their characteristics; but could be more profitable and survive longer. To overtake these obstacles, the literature shows that social networks are crucial for the creation of USOs [19,20], as shown, for example, in PhD students developing entrepreneurial networks [21].

Networks provide entrepreneurs information and resources important for the venture development [22]. In this vein, in general, bricolage concentrates in the explanation on how entrepreneurs use the resources they have at hand [23]. Contacts and networks are considered as a resource; therefore, the concept of 'network bricolage' arises, as a process in which the pre-existing contact networks are used as resources at hand for the entrepreneur-bricoleur [23]. Previous studies have empirically analyzed the relevance of entrepreneurial networks when developing new ventures [24], in particular how networks can be developed to access resources for different strategies and life-cycle phases [25], and how these entrepreneurs self-select formal versus informal networks depending on what they are looking for [26]. However, AEs have not been specifically addressed, as most of the previous research have been conducted at a macro level [5], and calls for more research at this individual level have been made [27,28].

This research uses the bricolage perspective to entrepreneurship [23], and analyze these main players, in particular how they self-select formal versus informal networks depending on what they need or are looking for. Consequently, our Research Question (RQ) is: How do AE overcome institutional barriers regarding networks?

As contributions, this paper extends the knowledge on the individual level of the development of entrepreneurial universities, showing how AEs still encounter institutional barriers and revealing the existence of a process of network bricolage process to develop their ventures in resource-constrained environments.

2. Theoretical Framework

2.1. Academic Entrepreneurship and Entrepreneurial Universities

Academic entrepreneurship is one of the ways in which universities' knowledge is disseminated and exploited by industry [29,30], resulting in university start-ups [7]. It is an expression of the engagement of researchers in Knowledge Transfer Exchange (KTE) [6,31] in the context of the entrepreneurial university [9–11,17,32]. This model of university is characterized by the existence of a supportive ecosystem to the university community which produces, diffuses, absorbs, and uses new knowledge, and these actions can result on entrepreneurial initiatives [11].

In this vein, if the universities want to contribute to societal progress, the interplay between the organizational embedment and the individual engagement in entrepreneurial activities is relevant [33]

and it is important to analyze how the institutional context influences an entrepreneurial behavior among academics [34]. Furthermore, the individual attributes of faculty members are important in academic entrepreneurship engagement, because the local work environment [35] conditions them. Due to its relevance, it is necessary to improve the knowledge about the relationships at the individual level (extent and antecedents) [18,19,26,36,37]. In particular, AEs who have past experience being entrepreneurs normally have a broader social network and are more effective in developing network ties than less experienced AE. These less experienced ones normally encounter structural holes between their scientific research/industry networks [38].

2.2. Social Capital

Social capital is a set of resources that are embedded in, available through, and derived from an individual's or an organization's network of relationships [39]. Social capital constitutes the goodwill available to individuals or groups, and its source lies in the structure and content of an actor's social relationships [40]. This paper put its focus in the network of relationships, considered as a valuable resource (that is, similar to financial capital) for individuals and organizations [39]. As social capital is relevant in explaining the probability of the survival and success of new business ventures, it can be considered as an important issue for AEs [41]. Through social capital, individuals have access to more sources of information, improving data quality, relevance, and timeliness [40,42]. In this sense, social networks, together with entrepreneur's personality traits and prior knowledge, are mentioned as antecedents of entrepreneurial alertness to business opportunities [43].

Concerning this process, Elfring and Hulsink [44] acknowledged the importance of an embedded network of strong ties to secure crucial resources. However, the structural characteristics at the team level change depending on the type of USO and the field of the AE [20], meaning that several questions about the network (content, governance, structure emergence, and development over time) remain unanswered [22].

Additionally, social interactions are channels through which information and resources flow and allow an actor to access the resources of other actors [45]. Indeed, individuals' access to external knowledge through the social networks in which they participate is fundamental for developing the capacity to recognize and exploit new business opportunities [46]. Consequently, social networks are determinant resources in the entrepreneurial process [23]. However, more empirical research is needed in order to understand how formal and informal contacts work in the starting point of the new venture for identifying business opportunities, especially in the case of AE.

2.3. Network Bricolage

Different approaches exist in the literature about how an entrepreneur develops an idea into a company at the beginning of the process, and thus, this is the starting stage. The most well-known ones include causation, effectuation, and bricolage [47]. Causation is the traditional prediction/planning approach. Sarasvathy [48] proposed effectuation as a new concept reflecting the logic of control in contrast to the logic of prediction (causation). Meanwhile, bricolage concentrates on the explanation on how the entrepreneur uses the resources they have at hand [23]. Bricolage is different to effectuation; while both imply starting with a set of means, bricoleurs may use materials at hand to see what they can do with the current resources (effectuation) and to find out how to meet pre-defined goals (causation) [23].

Bricolage was proposed by Lévi-Strauss [49] with his explanation of the bricoleur in contraposition to the engineer, referring to the use of the resources at hand. Baker and Nelson [50] defined bricolage in entrepreneurship as making do with the application of combinations of the resources at hand to new problems and opportunities. Since then, it has been studied extensively in organization and entrepreneurship theory [23,51,52].

As mentioned, in developing new ventures, the previous literature has stated the relevance of entrepreneurial networks. Thus, the access to contacts and the development of social capital

are important for the success of the new company [53]. In this context, contacts and networks are considered as a resource; therefore, the concept of network bricolage arises as a process where the entrepreneur-bricoleur uses their pre-existing contact networks as resources at hand [23].

According to Baker, Miner and Eesley [23], network bricolage implies networking or seeking opportunities and other resources through people who were previously strangers, in order to find new useful contacts. Interestingly, entrepreneurs who face institutional restraints engage in bricolage to reconfigure the existing resources at hand [54]. Network bricolage has been studied in artists, in particular regarding how they develop their bricolage networks [26] and in university settings, in particular applying bricolage to study the engagement of professors in curriculum change [55]. In this context, the difficulties to change things or do them in a different way, for example, in an entrepreneurial way, are particularly relevant, as universities are considered institutionalized organizations [56]. Additionally, strong network ties have been identified as beneficial because of their ability to facilitate the exchange of tacit knowledge and trusted feedback on opportunity identification by AEs [44]. In this vein, Walter, Auer, and Ritter [57] highlighted the relevance of network capabilities in USOs, defined as an entrepreneurs' ability to develop and utilize inter-organizational relationships. However, little is known about AEs and bricolage, and about how these entrepreneurs construct their bricolage networks [26] in resource-constrained environments. As mentioned, it is particularly relevant how they use their network (contacts) resources (network bricolage) in institutional contexts such as universities.

In this paper, it is studied how AEs use their existing contacts and networks, and seek new ones, involving themselves in a network bricolage process of dealing with formal and informal networks. As will be detailed later, this is characterized by starting the company in the context of difficult, if not negative, institutional settings, within a resource-constrained environment in terms of networks. Two types of network are in place: formal and informal. Firstly, as they work in an institutionalized organization, the type of network that they have in the first stages of the entrepreneurial project is provided by the institution [18,37] through, for example, the University Technology Transfer Offices (UTTOs). This network is considered to be formal. Secondly, in order to further exploit the business opportunities, the AEs look for new contacts, via social networking, in order to explore how these new contacts can help them to develop their business ideas [36,37]. This network is considered as informal.

Regarding this formal network, the university's staff working in UTTOs have had a legal background, as they were devoted mainly to protect patents and commercialize the technology from the university [5]. However, UTTOs' employees need to realize the relevance of opportunity recognition and exploitation as key entrepreneurial concepts and to have some commercialization and entrepreneurial skills [5]. Furthermore, the somewhat frequent fact that AEs bypass UTTOs may be something not done intentionally, but because the majority of researchers are not conscious of the services the UTTO at their university could provide to them. This awareness is greater among researchers who already possess experience as entrepreneurs or as taking part in research and consulting contracts with industry partners [58] and this needs to be further explored [5]. As a consequence, more research is needed in this area to increase our understanding of the wider role played by networks in entrepreneurial identification of business opportunities by AEs when developing their USOs. Consequently, the RQ of this study is:

How do AE overcome institutional barriers regarding networks?

3. Research Methods

3.1. Research Settings

According to the European innovation scoreboard published by the European Commission [59], Spain as a country is a moderate innovator and most of its economic indicators are closely above or below the EU average; what is particularly relevant is how the indicator measuring top R&D spending by enterprises per 10 million of the population is well below (4.5) the EU as a whole (19.6). In fact, R&D expenditure in the business sector in Spain is only half the level of the EU average, particularly

for large firms, with significant regional disparities [60]. The European Commission recommends [60] a stronger focus on public–private partnerships, cooperation between academia and business and technology transfer, particularly in favor of small and medium-sized companies.

In this context, Andalucía, according to the Regional Innovation Scoreboard 2019, published by the European Commission [61], is a moderate innovator and it is below Spain and the EU in terms of R&D expenditure by the business sector and patent/trademark/design applications. Moreover, after computing a ranking based on the Regional Innovation Index in 2019 comparing Andalucía with the rest of Spain [61], this region was in the 13th position out of the 18 autonomous regions and cities, with the regions of País Vasco, Catalonia, Navarra, and Madrid being in the highest positions.

In this paper, an empirical study was conducted in a convenience sample of AEs working in universities of the same ecosystem of the region of Andalucía. There are eleven science and technology parks, ten UTTOs (10 public universities and one private one), and several R&D centers in the region. Public universities, technological parks, and innovation centers are the key agents of the Andalusian R&D ecosystem, as there is a limited private presence in the system and most of the researches are in public universities [62].

3.2. Data Collection and Analysis

The whole process was divided into four subsequent phases. Firstly, we designed the empirical study to obtain in-depth information regarding AE in Spain. In particular, we studied the region of Andalucía as an exemplar of an ecosystem with common university legal regulations and financial support, as well as similar culture, thus constituting a homogenous context to study the behavior of AEs. We developed our own directory of relevant agents, contacting the UTTOs of all the Andalusian universities and using Internet searches, published reports, the previous literature and a snow balling process. We were interested in AEs who already started a USO and have had formal contacts with the university (defined as having signed a technology exchange with it in the last years), as this showed a formal structure of the venture. This also was a guarantee of selecting participants with similar experiences regarding their market activities, but with a variety of experiences regarding their institutionalized contexts, which could better inform our study.

Secondly, we defined a protocol for the interviews including a semi-structured questionnaire based on the literature review. This instrument included open questions based on previous research on social networks [24,40,44] and KTE [20,28,31] (see Appendix A). It contained information about UTTOs, research centers, USOs, other companies, and public institutions networks (formal and informal contacts), and the benefits or barriers to develop the new venture. We defined formal contacts as including those people who have engaged in a working relationship with the interviewee, and we considered informal contacts as those people that came from the personal sphere of the interviewee, such as relatives, friends, former coworkers or former employees.

Thirdly, as mentioned before, interviews were conducted with AEs who had experience in formal technology transfer with the University and were self-selected, based on their willingness to participate, from the database previously designed. Twenty-five AEs were interviewed, twenty of them were male, ten located in a technological park, and coming from different sectors, mainly IT (8), health and biomedicine (5), engineering (3), and others (9) (see Table 1).

Finally, we used a five-phase cycle for the analysis of the interviews [63]. It consisted of compiling, disassembling, reassembling, interpreting, and concluding the data collected previously. The results of the qualitative data are summarized next, using a narrative approach. In the interview analysis, the process of network bricolage in AE showed several general issues. Quotations from the interviewees, identified with the number of participant (as listed in Table 1), are cited in short in the next section in order to illustrate the main issues.

Table 1. Demographics of the participants.

Interview Case (P=Participant)	Face to Face	Phone	Gender	Province	Located in a Technological Park	Sector
P1		x	Male	Almeria	x	Engineering
P2	x		Male	Almeria	x	IT
P3	x		Male	Almeria		Services
P4	x		Female	Almeria	x	Services
P5	x		Female	Almeria		Health
P6		x	Female	Almeria	x	Health
P7		x	Male	Cádiz	x	Engineering
P8		x	Female	Cádiz	x	Services
P9		x	Male	Cádiz		Agrofood
P10	x		Male	Granada		Biotechnology and food
P11	x		Male	Granada		Health
P12	x		Male	Huelva		Services
P13	x		Male	Huelva	x	IT
P14	x		Male	Huelva		Nuclear
P15	x		Female	Málaga	x	IT
P16	x		Male	Málaga		IT
P17	x		Male	Málaga		IT
P18	x		Male	Málaga		IT
P19	x		Male	Málaga		IT
P20	x		Male	Seville		IT
P21	x		Male	Seville		IT
P22		x	Male	Seville	x	Energy, environment
P23	x		Male	Seville		Agriculture
P24	x		Male	Seville		Biomedicine
P25	x		Male	Seville	x	Engineering

4. Findings

4.1. Institutional Difficulties: The Need of Network Bricolage

From the analysis, an entrepreneurial bricolage process in AE emerges as a way of overcoming the still existing difficulties to start and develop USOs. These difficulties were grouped into five categories: general, information/trust, university support, way of working, and financing. They are presented in Table 2, with an edited summary of the elements of the key answers mentioned by the AEs.

Table 2. Institutional difficulties: the problem.

Difficulty	Elements
<i>General</i>	The government as the main barrier.
	Legal restrictions.
	Strict regulations to transfer from the university.
	Problems to manage and share the benefits of property rights/patents.
	The more technical activities are the important ones, and there are difficulties to transfer from more services related activities.
<i>Information and trust</i>	General lack of Information.
	Lack of knowledge about technology transfer, innovation, etc.
	Lack of knowledge: university and businesses do not know what each other need.
	Distance between technology/knowledge and marketable product.
	In the university, people do not like to share their ideas/knowledge.
	Lack of marketing knowledge from the university side.
	Lack of permeability of professors/researchers to the industry from the university and the other way around.
	Universities do not trust businesses.

Table 2. Cont.

Difficulty	Elements
<i>University support</i>	Bureaucracy of the university.
	Lack of proactivity from the universities.
	Lack of enough qualification, universities often put untrained fellows to execute contracts.
	Lack of real support from the regional government after the initial stage.
	Lack of real support from the university.
<i>Way of working</i>	Lack of support to hire R&D people.
	The way that the university and businesses work is very different.
<i>Financing</i>	Academic culture: timing is different from companies.
	General lack of financing.
	Economic barrier: companies want to invest little in their relationship with the university.
	Lack of appropriate investors that could value innovation.

AEs mentioned several institutional difficulties, including the need for a more proactive role of UTTOs, the difficulty to be recognized as a USO, the legislation and bureaucracy of the University (too many regulations impede knowledge transfer and entrepreneurship from the University), and the academic culture (timing is different for companies). They also mentioned the mutual lack of knowledge (University and businesses do not know what the other needs are), financing, and lack of real support from the regional government after the initial stages. Regarding these institutional barriers, it was mentioned specifically that UTTOs sometimes are an obstacle for academic entrepreneurship and these institutions need a more proactive orientation. It is sometimes an enabler at the beginning, but it becomes a barrier with time, timing, and legislation. As a consequence, AEs look for an alternative in order to avoid the intermediation of the UTTO and need to seek for new resources in terms of contacts (informal networks). For example, it was stated that “the UTTO is an obstacle more than an organization that helps” (P21).

Another main obstacle for entrepreneurship from the formal network is the lack of understanding of what they try to do in some areas, for example, “to start the USO with the support of UTTOs, for non-engineering based activities is more difficult, you spend more time explaining the project” (P21).

In terms of access to other recourses at hand, “my relatives are my financial sources” (P22) and “as USO, you can use the University resources” (P9). As a consequence, the network bricolage between formal and informal networks arise in order to avoid these barriers.

4.2. Network Bricolage

In principle, AEs mentioned formal and informal networks as important. On the one side, the network resources the entrepreneurs have at hand, the so-called formal networks provided by the institution, became more important as the company relates to more sophisticated areas of knowledge (biomedicine, IT, etc.). In this vein, formal networks promoted more opportunities, especially in high tech companies (the participants mentioned that it is difficult to explain complex activities to friends).

Informal networks, on the other hand, contributed to promoting trust between people, are important for word-of-mouth and, in the end, become crucial to connect to the correct people in order to introduce new products/services in the market. In sum, they provided previous and new contacts, new collaboration ideas, sometimes access to finance sector, and, overall, they had more agility than formal networks. Consequently, AEs use them in order to explore new business opportunities. Additionally, another important issue that arises is that informal network relationships are less frequent in entrepreneurial contexts, but they are considered to be more valuable than formal network relationships by AEs.

Regarding how AEs developed their network bricolage, both the formal and informal networks were considered by analyzing and interpreting the transcripts. Some issues related to both networks emerged as relevant, and they are summarized and accounted for in Table 3. In this table, a ‘see-sawing’

between both networks can be seen, and this is shown in the percentage for formal versus informal networks that the participant uses to solve the mentioned institutional barriers. The use of both networks is illustrated with a list of the specific purposes the participants declare.

Table 3. ‘See-sawing’ between formal and informal networks: the solution.

Case	Formal Networks						Informal Networks						
	% Formal Network	Development Opportunities (New Projects and Business)	Contacts	Security	Knowledge Exchange	Infrastructure and Human Resources	Personal Support	Collaboration and Building Trust	Financial Resources Collaboration	Knowledge Exchange	Development (New Business and Markets)	Contacts	% Informal Network
P7	100%		✓	✓									
P8	100%	✓	✓		✓								
P15	100%											✓	
P16	100%										✓		
P20	100%			✓									
P24	100%	✓	✓		✓								
P21	95%									✓			5%
P12	90%	✓									✓		10%
P23	80%				✓		✓			✓			20%
P22	70%								✓				30%
P1	50%	✓										✓	50%
P2	50%											✓	50%
P9	50%		✓			✓				✓		✓	50%
P11	50%										✓		50%
P13	50%	✓		✓								✓	50%
P19	50%							✓		✓	✓	✓	50%
P18	30%												70%
P3	20%						✓			✓	✓		80%
P4	20%	✓				✓							80%
P5	20%									✓	✓	✓	80%
P6	20%	✓											80%
P10	20%						✓			✓			80%
P14	10%										✓		90%
P17											✓	✓	100%
P25								✓			✓		100%

As stated by one of the entrepreneurs (P21), “it is much more frequent the contact from the USO to the UTTO than the opposite”, this being an example of using the resources at hand, as stated by the bricolage concept.

There is a question as to the relevance of how network relationships begin as formal and become more informal in later stages and whether these relationships changes are significant to the entrepreneurial bricolage. The explanation might be that new start-ups ultimately evolve into trading companies and they look for networks that are more informal. However, at the beginning, they use their network resources at hand (in the institutions, formal network, and friends or relatives, informal networks) in order to put into practice their entrepreneurial bricolage.

Regarding formal networks, some AEs, especially from engineering-based companies, consider that these networks were determinant in the starting stage of the company, because they need to protect their products and provide scientific infrastructure. Then, developing new projects and new business opportunities is also important because it facilitates contacts with other major players, such as institutions and companies, which may be valuable in order to exploit new projects. Some transcriptions that illustrate this are:

“Our market is special and we need to sign strict confidentiality agreements”. (P7)

“I think that for our case, software engineering, the formal relations are the most relevant as it is difficult to explain our products and services to friends or relatives”. (P13)

“There are more opportunities in the formal network; in the informal we have got only new contacts for starting collaboration”. (P1)

Concerning informal networks, these networks are determinant resources to start the company (personal support):

“Informal relations are key. Most the time if you do not tell others about your problems you are losing opportunities of finding a solution”, “the informal network is relevant for new ideas and new contacts”. (P9)

“I speak to people from my personal sphere about my business and I got new ideas and new contacts. I also got new business ideas from clients”. (P3)

“Having a drink with a workmate is good to speak about new ideas and they could motivate you. I think is the informal network that motivates you to start the business”. (P14)

In later stages, the network contributes to promoting trust with new institutions and companies:

“Having a coffee is a good starting point to have an initial idea or an initial agreement of potential projects. Moreover, it helps to have better relations with this people, gaining trust with the people you are going to collaborate, developing empathy and preventing possible problems that may arise because there is not an understanding of each other point of views. These informal relationships contribute to have better relations promoting trust among the people involved in the project”. (P19)

They also facilitate the knowledge exchange and the contacts for developing new business models and to attract new markets:

“Through informal networks people know you, how you are and how you work and you trust on the people of your informal networks and that they are going to give correct information about you. In the end, new projects arise because of this”. (P19)

After this analysis, it can be said that formal networks are not always the most relevant to AE; in some way, a mediated effect of the informal network is present, so there is a complementarity effect between both types of networks. For example: “We have tried to use the formal relations, and finally we got nothing. For us, only the informal relations work”, “informal networks have provided us contacts” (P13), and, on the contrary, “just to make contacts with family ties or old friends network is not enough”. (P25)

5. Discussion

We will discuss our main findings following this structure: social capital, the need of network bricolage, network bricolage, and intermediaries.

5.1. Social Capital

Similar to previous studies, strong ties have been identified as beneficial in facilitating the exchange of tacit knowledge and trusted feedback (in both networks) for the identification of opportunities by AEs [44]. Answering De Klerk's [26] call for more research in this specific area, we have described how AEs behave in self-selecting their formal and informal networks depending on what they are looking for, as both networks offer different benefits. It is clear that AEs use social networks, both formal and informal. The characteristics of the personality of entrepreneurs and previous knowledge are previous conditions which enable them to be alert about business opportunities [43] and to recognize/exploit them [46]. The participants perceive informal networks as important and the role of social capital as a valuable resource [39,40,46] for opportunity identification. AEs use formal networks for the development of opportunities (new projects and business) and informal networks for the development of the company (new business and markets). Furthermore, AEs practice networking to seek opportunities and other resources through people who were previously strangers [23] in these formal and informal networks.

They use social networks to access to broader sources of information [40]. This network bricolage allows AEs to interact in formal and informal networks where information and resources flow, allowing an actor to access the resources of other actors [45]. In this case, AEs select the channels to use from the networks (formal and informal) they have at hand. The use of these networks allows AEs to have a greater knowledge acquisition, similar to the findings of Yli-Renko, Autio and Sapienza [42].

5.2. The Need of Network Bricolage

Similar to what previous studies did in the general KTE context [64], we have identified several institutional barriers to AEs, which we have summarized in five factors: general difficulties, information and trust, university support, way of working, and financing. First, general difficulties for KTE [65] are also applicable for AE, for example, regulations in universities are still a present problem, similar to the previously found lack of flexibility/bureaucracy [66]. Regarding information and trust, we confirm that information is still a problem [65], and this is also reflected in the lack of sharing information that could contribute to distributing best practices from other AEs, avoiding, consequently, positive cohort effects [67], which have been pointed out in the literature as critical for the successful spread of these types of practices [67]. In addition, as Vaz, de Noronha Vaz, Galindo, and Nijkamp [68] identified, there is the importance of trust building, which is affected by informal networks. Formal networks were highlighted as relevant due to the technological nature of the USOs.

Concerning university support, AEs are affected by the capacity and motivation [65] of the personnel of the UTTO. Furthermore, there is a difference between the universities and businesses in the way of working. In this vein, aspects such as the lack of flexibility/bureaucracy [66] and the different cultural norms [65,66,69] emerged in the analysis. Finally, similar to previous research about KTE in general [65], financing the activities arose as a difficulty.

5.3. Network Bricolage

AEs behave as entrepreneurs-bricoleurs, using their pre-existing networks as resources at hand [23]. In this network bricolage between formal and informal networks, different factors have been found as relevant for entrepreneurial opportunities identification and exploitation, both for formal networks (security, knowledge exchange, development opportunities/new projects and business, contacts, infrastructure and human resources) and for informal networks (contacts, personal support, collaboration and building trust, financial resources collaboration, development/new business and markets, and knowledge exchange). AEs perform bricolage as a way of making do with the application of different combinations of the resources at hand [50], in this case formal and informal networks, to solve difficulties and answer to opportunities.

5.4. Intermediaries

There are some negative feelings about intermediaries in AEs. It is shown how UTTOs have to be present at the beginning, but they are later ignored, so their role as institutional promoters of entrepreneurs [70] and as agents in the regional networking activities [71] is questioned. In the network bricolage, we found as relevant the difficulties in dealing with UTTO staff who have traditionally been people with a legal background [5], which, in turn, produces a UTTO bypass [58] by AEs, questioning the relevant role of these intermediaries in the regional knowledge ecosystem. Moreover, we found this to be intentional; we found AEs who did not want to go through this office, but also a lack of information and awareness about the existence and services of the UTTO.

These UTTOs are perceived as needing to understand key entrepreneurial concepts (opportunity recognition, exploitation) and to have more commercialization and entrepreneurial skills, as pointed out by Siegel and Wright [5]. This might have important consequences for its alleged role as a key facilitator in regional development [68] and as a critical element to the successful transformation to an entrepreneurial university [72]. Consequently, more awareness actions are needed, according to, for example, the found UTTO bypass by researchers, simply because they are not aware of their existence in their universities [58].

6. Conclusions

AEs develop their business projects in institutionalized organizations and have to deal with different difficulties, which surprisingly still exist. These barriers are particularly relevant for AEs regarding building social capital. We describe this phenomenon as a ‘see-sawing’ process between formal versus informal networks.

As contributions, this paper extends the knowledge on the individual level of the development of entrepreneurial universities in four ways. First, it shows how AEs encounter institutional barriers in universities, which make building social capital difficult [19]. Second, it enriches the knowledge on the process of exploiting business opportunities of AEs in non-favorable institutional settings. Third, it describes how the networks are developed to access resources for different strategies and life-cycle phases of the entrepreneurial process [25]. Fourth, it reveals the existence of a relevant network bricolage process of these AEs using what networks they have at hand (‘see-sawing’ formal versus informal) to develop their ventures, extending the knowledge on how and why these entrepreneurs self-select formal versus informal networks depending on what they are looking for [26]. This bricolage process helps with the institutional barriers, answering the RQ.

The implications can be summarized for policy makers, universities, and AEs. For policy makers, this study exposes the unexpected fact that, taking into account the important effort that has been put in place in developing entrepreneurial universities and academic entrepreneurship, informal means were used to overcome still existing barriers. In particular, network bricolage facilitates entrepreneurial positive attitudes to develop a real venture in a somehow ‘penurious’ context in terms of needed social capital. In addition, the relevance of social capital was identified by the fact that the most successful initiatives involved opportunities for researchers and the employees of USOs to work together on collaborative projects, rather than to simply acquire or license products or services from universities. This social capital fosters the recognition of entrepreneurial opportunities, and, therefore, entrepreneurship. As Pavlin, Kesting and Baaken [33] pointed out, there is a need for a better support from different university levels in order to increase the engagement in entrepreneurial activities of the different individuals.

For universities, the revealed network bricolage process illustrates the need for entrepreneurial universities to improve the support for AEs in terms of social capital building. At the individual level, these institutions should create and develop appropriate formal and informal networks of entrepreneurs and stakeholders, through a supportive ecosystem, as this is key for their success. Moreover, they should take a more proactive role when fostering academic entrepreneurship and address barriers that still exist (i.e., bureaucracy, lack of confidence), developing themselves as network

hubs for the support of entrepreneurs. Promoting academic entrepreneurship is more a question of raising opportunity recognition by interacting with other individuals than only engaging in formal processes and activities. UTTOs should continue supporting administration processes but they should also become institutional entrepreneurs [70]. In addition, policies to promote the entrepreneurial culture of researchers are needed, including the involvement of the University managers, more incentives, and teaching methods that include entrepreneurial experiences [73].

For AEs, it is important that they adopt a more proactive role in building and ‘see-sawing’ between both types of network (formal and informal) as an important way of overcoming the lack of knowledge, building trust, and improving word-of-mouth about their companies, which over time benefits the development of the entrepreneurial University.

Regarding limitations, whilst this study is based on twenty-five interviews, the results are relevant for the analyzed context, and worldwide as a way of illustrating network bricolage by AEs in an institutionalized context. However, as Fini, Grimaldi, Santoni, et al. [12] also pointed out, the findings could be caused by the regional settings’ idiosyncrasies that might be seen also as a limitation of the results of this study. More data from other contexts and countries would help to increase the value of the analysis. In addition, a quantitative study with more data coming from all the agents involved in academic entrepreneurship would add more value to the results. However, due to the nature of the network bricolage, the conducted study based on qualitative data is considered to be appropriate. Furthermore, this is an exploratory approach to study bricolage at the individual level, thus AEs have been analyzed in the context of the universities as institutions. However, we have not considered or controlled the empirical study by the intensity of the institutions that promote academic entrepreneurship in the region. Finally, the international cooperation of the university, the type of scientific discipline, and the location of scientific institutions in existing industrial clusters have not specifically being considered and would have enriched the analysis. All of this might be included in further research.

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Appendix A

Interviews Script

General information:

1. Name
Organization
Location
Main tasks
2. Economic sector of the company
3. Academic spin off/Non-academic spin off

Definition:

4. What do you think about the transfer of technology/knowledge from the University (in general)?

Activities:

5. What technology/knowledge transfer activities are being carried out in your organization at this time? Which ones are you personally involved in?
6. What other technology/knowledge transfer activities do you have experience in?

7. Which were the most successful? Why?
8. Which were the least successful? Why?
9. How do you know? Do you use any method of evaluation of technology/knowledge transfer?

Contact networks:

10. Which people or institutions do you usually contact to carry out technology/knowledge transfer activities? Indicate them in this list:
 - UTTO office of your nearest University.
 - Research Centre.
 - Academic spin-offs.
 - Non-academic spin-offs.
 - Other companies.
 - Other public institutions.
11. How often do you usually contact them?
 - UTTO office of your nearest University.
 - Research Centre.
 - Academic spin-offs.
 - Non-academic spin-offs.
 - Other companies.
 - Other public institutions.
12. What do you expect to get? To what extent are you getting it?
13. What people or institutions usually contact you to carry out technology/knowledge transfer activities?
 - UTTO office of your nearest University.
 - Research Centre.
 - Academic spin-offs.
 - Non-academic spin-offs.
 - Other companies.
 - Other public institutions.
14. How often do they usually contact you?
 - UTTO office of your nearest University.
 - Research Centre.
 - Academic spin-offs.
 - Non-academic spin-offs.
 - Other companies.
 - Other public institutions.
15. What do you expect to get? Do you think those expectations are usually met, how do you know?
16. If we distinguish between networks of formal and informal contacts
 - a. Formal network: those people with whom you have an employment relationship
 - b. Informal network: those people who come from the personal sphere, such as family, friends, former co-workers or former employees.

Where would you include the people or institutions you usually contact to carry out technology/knowledge transfer activities? Express how important (in percentage) each group has for technology transfer.

17. Of both types of named relationships (formal and informal), which ones do you further encourage the discovery of business opportunities/business creation? Indicate an approximate percentage to each group.
18. What entrepreneurship activities are most encouraged with each type of network, formal and informal (examples of entrepreneurial activities: new contacts, new business ideas, resources, recognition)?
19. And how do these networks affect the transfer of technology and/or knowledge?

Benefits:

20. Why do you think the transfer of technology/knowledge from universities to companies is important?
21. What are the potential benefits for universities that transfer technology/knowledge?
22. What are the benefits of technology/knowledge transfer for companies?
23. Who else benefits from technology/knowledge transfer?
24. Do you think there is any opportunity cost related to the transfer of technology/knowledge (for researchers/companies/University/society)?

Barriers:

25. What, if any, are the technology/knowledge transfer barriers you have encountered? And as for the creation of the spin-off?
26. How, if any, did you overcome these barriers?
27. Have you had any problems when transferring technology/knowledge? And as for the creation of the spin-off?

Support:

28. What kind of activities does your organization carry out to encourage/support/facilitate the transfer of technology/knowledge?
29. Of those activities, which are the most successful? How do you know?
30. What else could you or your organization do to support technology/knowledge transfer?

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